

IPOLE-WPK Woodpecker Hole Repair

and

IPOLE-WPK Woodpecker Detering Systems

Presented by: Phil Landers
ICORP-IFOAM Specialty Products Corporation
Presented at: **Global ESMO 2003**
April 6-10, 2003
Orlando, Florida

Introduction

Woodpeckers continue to be an expensive nuisance to utilities in many parts of the world. Rather than declaring this unique and beautiful bird our enemy, a review of the results of more than 30 years of research into woodpecker behavior, damage restoration, and deterrence can point the way to economical woodpecker control. This paper summarizes the results of this research. Topics that are discussed include woodpecker behavior; structural repair of woodpecker damaged poles; and a newly developed, proven method of woodpecker deterrence.

Background

Woodpeckers, with their distinctive feeding and behavior patterns, continue to be in direct conflict with the economical operation of utilities' wood pole facilities. For more than 15 years, **ICORP-IFOAM** Specialty Products Corp. has researched and developed systems designed to both structurally repair woodpecker-damaged poles as well as to deter woodpeckers from inflicting further damage to these poles. The following sections will review these proven systems and announce a major break through in proven, economical woodpecker deterrence.

Anatomy of Woodpecker Hole Repair

Repair of a woodpecker damaged pole is a complex engineering problem that involves more than just filling the hole. Because these holes are typically decayed, true structural repair requires that all aspects of the DECAY problem be addressed.

Woodpecker hole repair can be broken up into three distinct requirements:

- **Structural** repair of the damaged area;
- **Eradication** of the decay; and
- **Deter** woodpeckers from continuing to inflict damage to the pole.

The **TOTAL SOLUTION** to the woodpecker hole repair problem **MUST** address each of these important areas. Failure in even one constitutes but a bandaid on the problem rather than its true solution.

ICORP's patented **IPOLE** Systems (**IPOLE-WPK** Woodpecker Hole Repair and **IPOLE-WPD** Woodpecker Detering Systems) are the only products on the market proven to successfully address each of these stringent requirements.

Structural Repair of the Damaged Area

While the term "structural repair" sounds simple, several factors are present that add significantly to the complexity of the problem. First, woodpecker holes that penetrate the treated shell of the pole often contain DECAY. True structural repair requires that the repair material bond to solid wood, not just to the decay. Secondly, to affect a true structural repair, it is important that the stiffness of the repair material match the stiffness of the wood. Unmatched, high stresses can be induced around the repair that can lead to structural failure.

Structural bond to solid wood requires that the repair material penetrate the decay and bond to solid wood. Conventional adhesives (epoxies, polyurethanes, etc.) only adhere to the surface that they come in contact with and do not to penetrate through it. In the case of woodpecker holes, they bond well to the DECAY. The problem is that the decay is itself not structurally bonded to the solid wood. Without a structural bond to solid wood, true structural repair is not possible, no matter the strength of the filler.

IPOLE-WPK Woodpecker Hole Repair System

ICORP's patented **IPOLE-WPK** Woodpecker Hole Repair System is the only repair system on the market that penetrates the decay and bonds to the surrounding solid wood. Using an expanding epoxy polymer concrete, **IFOAM**, the molten epoxy is driven through the decay and into the solid wood, where it then hardens.

Bond through the decay and onto solid wood. **IFOAM** is a catalyst cured, carbonated, expanding, epoxy polymer concrete that is made up of a unique blend of epoxy resins, graded aggregate, and 3-dimensionally *intertwined* Fiberglass and carbon fibers.

Using its unique chemical composition, **IFOAM** incorporates three distinct physical mechanisms to penetrate the decay:

1. **Low Viscosity.** As the **IFOAM** cures, its exothermic heat of reaction rises to over 300°F. At this temperature, **IFOAM's** viscosity is reduced to less than that of water.
2. **Static Force.** Confined, **IFOAM** expands with a pressure of approx. 2.5 psi.
3. **Dynamic Force.** Dynamic pulsing forces are developed along the inside perimeter of the hole by the continually developing-collapsing action of the CO₂ bubbles at the **IFOAM/wood** interface.

This unique combination of high temperature, low viscosity, and combined static and dynamic forces, drives the molten liquid epoxy through the decay and into the solid wood where it cures and hardens.

In addition to its high penetration, the patented **IPOLE-WPK** process provides a high-strength fiber liner around the interior walls of the cavity. This high-strength liner is formed by the filtering action of the wood as the molten epoxy is driven through the decay. Filtered from the **IFOAM** matrix, the deposited 3-dimensionally *intertwined* fiberglass fibers form a high-strength, 2-dimensionally *interlocked* and *interwoven* fiberglass liner on the inside walls of the cavity.

Stiffness of the repair material must match that of the wood. Wood poles demonstrate a high degree of flexibility under structural load. Thus, it is important that the stiffness of the repair be matched as closely as possible to the stiffness of the wood pole. If the repair material stiffness is significantly HIGHER than that of the wood, a high stress point can develop at the repair that can lead to premature structural failure. Likewise, if the repair material stiffness is significantly LOWER than that of the wood, structural stresses are not transferred through the repaired section, a situation that can again lead to failure.

Some commercially available woodpecker hole fillers are being marketed for the repair of both wood and concrete poles. Because the stiffness's of wood and reinforced concrete are so different, a repair material whose stiffness is designed for concrete poles would not be appropriate for repair of a wood pole, and visa versa.

Stiffness of an **IPOLE-WPK** repaired woodpecker hole is designed to closely match the stiffness of the in-service wood pole.

Decay Eradication

Woodpecker holes that breach the preservative treated shell of a wood pole are susceptible to DECAY. Unless this decay is eradicated, deterioration of the wood surrounding the repaired section will continue.

Conventional polymers (epoxies, polyurethanes, etc.) used as woodpecker hole fillers do nothing to eradicate the decay. Use of toxic chemicals with these fillers can cause safety problems to installers as well as restrict bond to the surrounding wood.

The **IPOLE-WPK** System is designed to sterilize the wood surrounding the cavity as well as to provide longer-term protection around the repair. Wood sterilization is accomplished by **IFOAM's** high exothermic heat of reaction that reaches temperatures in excess of 300°F. In addition, **IFOAM** contains a high-penetration solvent that is released into the wood during expansion. Using available moisture to migrate through the wood, the solvent reacts with and reactivates any preservative (i.e., creosote and pentachlorophenol) that may be present. Longer term protection is accomplished by the addition of micro-capsules of **ICORP's** patented **IPOLE-WPD** Woodpecker Deterrent that are also incorporated into the **IFOAM** structural matrix.

Deter Woodpeckers From Continuing to Inflicting Damage to the Pole

In addition to structural repair and decay eradication, an effective wood pole management program requires that continued woodpecker activity be stopped. Left undeterred, woodpeckers, especially pileated woodpeckers, will try to remove the repair material from the repaired nesting cavities.

Conventional woodpecker hole fillers do nothing to dissuade further woodpecker activity on the pole. On the contrary, woodpecker activity around repaired holes appears to accelerate, especially around newly created nest holes.

The **IPOLE-WPK** System incorporates micro-capsules of the patented **IPOLE-WPD** Woodpecker Deterrent inside the **IFOAM** that have proven effective in stopping continued woodpecker activity in the applied areas.

Product Packaging vs. Shelf-life

Any discussion of woodpecker hole repair products would be incomplete without a look at the various packaging techniques being used and their effect on product shelf-life.

Two types of packaging/delivery systems are primarily being used with commercially available woodpecker hole repair systems; caulking tubes/guns, and polymer barrier pouches. Before discussing the pros and cons of each, basic facts regarding the physical characteristics of polymers must be considered:

- All polymer systems used in woodpecker hole repair contain fillers that, over time will **SEPARATE** from the liquid resin or hardener. The amount of time required for settlement to occur is directly dependent on two primary factors; material viscosity and storage temperature.
- Mixing ratios of epoxy systems used as woodpecker hole fillers are generally in the range of 100 parts resin (Part A) to 40-60 parts hardener (Part B). Thus, packaging Parts A and B in similar sized containers requires that substantial fillers to be added to the hardener to make the resin and hardener volumes equal.
- Polymer systems, whether epoxy or polyurethane, require exacting mixing ratios of resin to hardener. Mis-ratios of as little as 5% can have a major effect on the performance of the cured polymer.

Caulking tube systems, while simple to use, have one major limitation, they reduce product shelf life by allowing settlement of the filler to occur inside the rigid container. To fully understand the influence that settlement can have on the performance of the cured polymer it is important to evaluate how much filler is being used and how its presence influences product packaging and shelf life.

Volume of filler used in a specific product must be disclosed in the manufacturer's Material Safety Data Sheet (MSDS). A review of the MSDSs for the commercially available woodpecker hole repair materials reveals filler levels in Part A (resin) and Part B (hardener) of as much as 50-70%.

Polyamines curing agents are often used as hardeners in epoxy resin systems. Recommended mixing ratios in the range of 1 part resin to 0.5 part hardener are typically recommended for proper curing of these systems. Variations of these mixing ratios of as little as 5% can have serious ramifications to the cured polymer. The most significant of these problems arise when using polyamine cured epoxies in caulking tube-type systems.

Because the mixing ratio of polyamine hardener to epoxy resin in these systems is so radically different, using the same size caulking tube to package both resin and hardener requires that a significant volume of filler be added to the hardener to make the volumes uniform. The problem arises when the filler is allowed to settle to one end of the tube. Mixing ratios throughout the entire tube are then compromised. Why does this happen in caulking tube-type systems?

Many of the polyamine hardeners are classified **HAZARDOUS** and/or **CORROSIVE** (see individual Material Safety Data Sheets). Because caulking tubes are not sealed, heating of the product can lead to chemical leaks as a result of thermal expansion and associated viscosity reduction. The method most commonly employed to prevent leakage is to store the tubes tip down. While solving the hazardous chemical spill problem, a shelf life problem is created when the filler settles to the tip end of the tube. When this the product is dispensed, the **FIRST** material to be ejected from the tube is **RESIN RICH**.

That is, there is insufficient hardener (too much filler) at the tip-end of the cartridge to effect an adequate cure. Conversely, the LAST of the product to be dispensed (plunger-end of the cartridge) will be **HARDENER RICH**. That is, the mixed polymer contains **TOO MUCH HARDENER**. This can cause severe shrinkage cracks to develop, leading to a loss of structural integrity and possibly catastrophic failure.

Examples of the effects of filler separation in a caulking tube-type system are illustrated in the pictures in Figures 1 and 2. The resin rich polymer injected from the tip end of the caulking tube cartridges never hardened (sample more than 5 years old). The hardener rich polymer injected from the plunger end exhibits shrinkage cracks that extend across the entire width of the cavity. From the outside, the repair appears structural. In reality, this lack of structural integrity can potentially lead to catastrophic failure.

IPAK Polymer Pouches. In contrast to packaging in caulking tubes, the **IFOAM** used in the **IPOLE-WPK** Woodpecker Hole Repair System is packaged inside specially designed, proprietary **IPAK** polymer pouches that allow the manual re-blending of settled fillers while still inside the pouch. **IFOAM** has an extended shelf life, when packaged in **ICORP**'s proprietary **IPAK** polymer pouches.

Used successfully by utilities throughout the U.S. for more than 15 years, the **IPOLE-WPK** Woodpecker Hole Repair System continues to provide the **TOTAL SOLUTION** to structural woodpecker hole repair.

Cost-Effective Woodpecker Deterrence Now a Reality

After more than 15 years of research and development, **ICORP** announces the commercialization of a patented, cost-effective woodpecker deterrence system, the **IPOLE-WPD Woodpecker Detering System**. Proven effective through years of field tests, the unique **IPOLE-WPD** technology provides the framework for economical and safe woodpecker deterrence.

The following sections will review the research results that led to **IPOLE-WPD** development:

Background of Chemical Woodpecker Deterrent Research

Research into woodpecker deterring chemicals, conducted in the 1970's, found that a commonly available industrial solvent to be particularly offensive to woodpeckers. While this pioneering work was limited to smaller woodpeckers, it pointed the way to **ICORP**'s development of the patented and proven **IPOLE-WPD** System. This chemical solvent has been used for decades in common industrial and household products such as paints, inks, and adhesives, and has been tested and proven safe for use around birds, animals, and humans.

After significant testing, two primary factors were found to impact the effectiveness of this approach; deterrent concentration, and longevity. Required concentrations were found to vary between species of woodpecker. In general, the larger the woodpecker the higher concentration that was required.

Various paints and polymers were evaluated for compatibility with the deterring solvent. Conventional paints and polymers were not compatible at the higher solvent concentrations required. In addition, solvent volatility in conventional coating systems limited its longevity.

The solution was to micro-encapsulate the deterrent and adhere the capsules to the wood's surface. When these micro-capsules are ruptured, the liquid deterrent is released.

Because the deterrent is a solvent, use of conventional encapsulation methods were not possible. After many of years of research, **ICORP** successfully developed a method of encapsulating this solvent-based deterrent. This technology forms the basis of the patented **IPOLE-WPD Woodpecker Detering System**.

While field tests showed this method of chemical deterrence to be highly effective, the physical deterring mechanism remained a mystery. Because woodpeckers, and birds in general do not have a sense of taste, this was ruled out as the primary deterring mechanism. Further tests were conducted to understand how the **IPOLE-WPD Woodpecker Detering System** actually works.

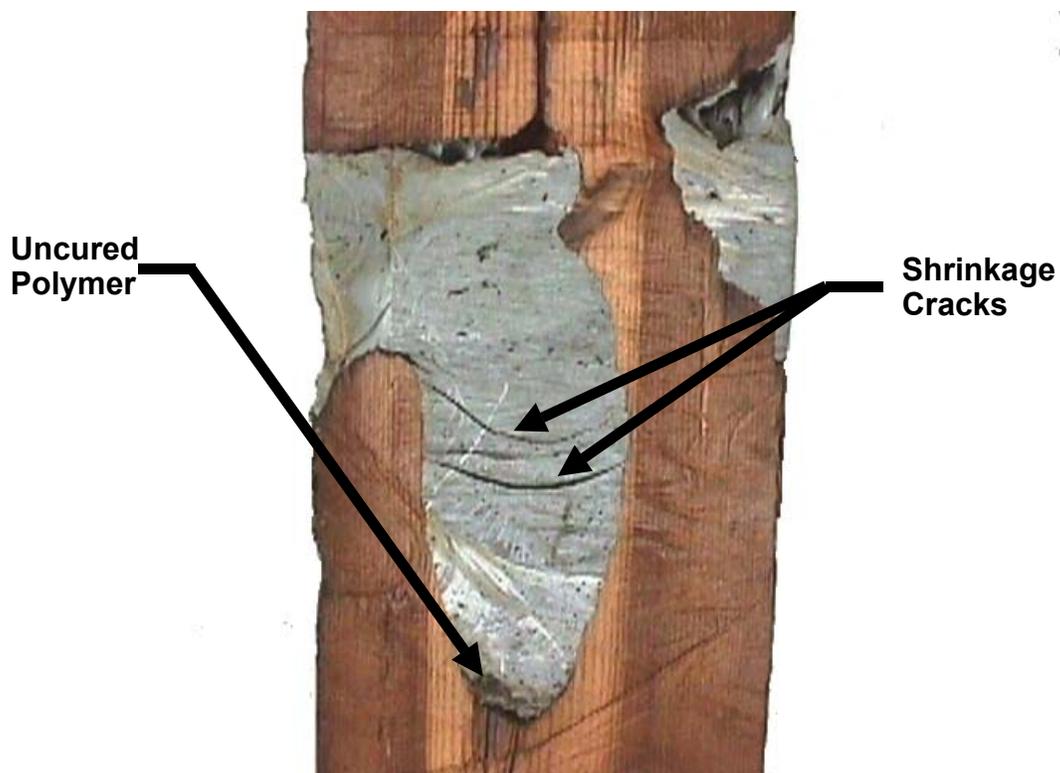


Figure 1.
Results of filler separation inside rigid containers.

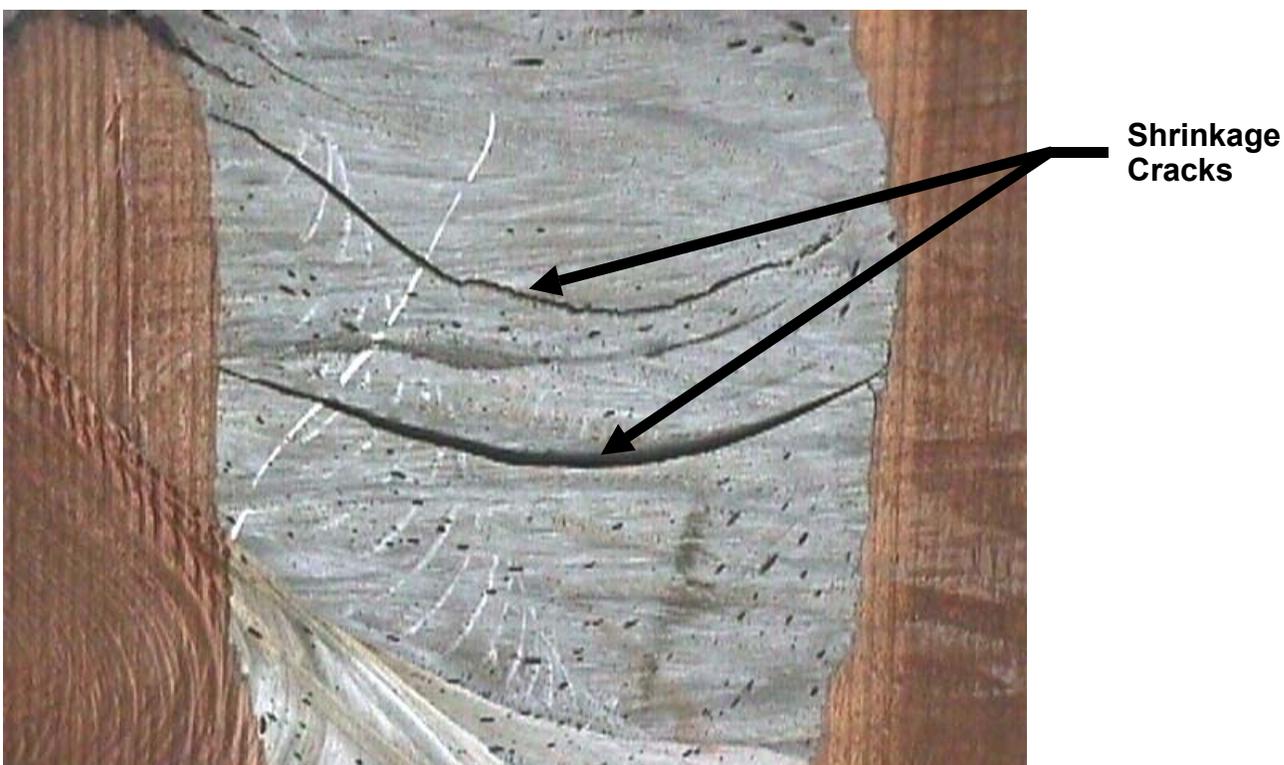


Figure 2.
Cracks extending across entire cross-section

How does the IPOLE-WPD System Work?

Insight into the deterring mechanism came from research done on another species of animal, horses. The problem was wood chewing. It seems that horse physiology dictates that they feed (or chew) 12 to 16 hours a day. When stalled or confined, this need to chew is often directed at structural wood members, specifically wooden fences, stalls, gates, etc.. Wood chewing is a problem as it can lead to serious equine health problems including intestinal disorders and colic.

Tests were run to determine if the **IPOLE-WPD** technology could be used in behavioral modifications of warm-blooded animals as well as for woodpeckers. Chewing surfaces of fences, stalls, and paddocks were painted with the **IPOLE-WPD** putty and **the wood chewing behavior stopped!** Again the mystery, what was the mechanism that caused the chewing to stop? Since no marks were found on the painted surfaces, sense of taste was ruled out as there was no indication that they had even tested it to be able to draw this conclusion. It was apparent that another of their senses was being adversely affected.

Another series of tests were run that consisted of exposing several horses to pieces of wood that had been painted with the **IPOLE-WPD** putty. **IPOLE-WPD** was cured to the point where the solvent smell was almost impercievable (release levels of approximately 0.2 ppm). With the horses in their stalls, each horse was allowed to smell the painted wood. Every horse demonstrated a definite dislike for the smell! We now had our mystery sense -- **SMELL!**

According to animal behavioral scientists, woodpeckers, and birds in general, don't have a sense of taste as we know it. However, birds' and animals alike have a sense of smell that can be as much as a hundred times more sensitive than humans. Based upon these results, **IPOLE-WPD's** effectiveness appears to be related to birds' and animals' acute senses of smell.

With the deterring technology proven and understood, economics of **IPOLE-WPD** application had to be developed. Is it necessary to coat the entire pole or is there a more cost-effective method? Understanding the basics of woodpecker behavior led to the **IPOLE-WPD System's targeted approach** to woodpecker deterrence.

Woodpecker Behavior, the Key to Cost-Effective Deterrence

A cost-effective woodpecker deterrence program requires an understanding of woodpecker behavior and an answer to the question, "Why do they attack a treated wood pole?"

Most wild birds and animals spend a large portion of their time foraging for food. While the techniques employed in this search vary widely, the woodpecker's resounding *rat-tat-tat* is distinctive. Mastered through thousands of years of evolution, woodpeckers use their highly-developed, built-in sonic testing device, their pecker, in what seems to be a never ending search for food.

Woodpeckers feeding patterns are well documented and systematic. The following is a simplified explanation of this behavior: Once the woodpecker has selected a tree, he methodically pecks (sonic tests) its entire length looking for voids under the surface of the wood. Experience has taught them that the presence of these voids can lead to their favorite meal - BUGS.

Once a void has been located, pecking is initiated in an effort to drive the insects out for a quick meal. If insects don't appear, additional pecking ensues to provide the insects with an exit hole from which the woodpecker can feed. Referred to as "peck-outs" or "foraging holes", these smaller holes are important as they provide a visual indicator of the most promising locations for future feeding activities. Better said, **THEY WILL BE BACK!**

How do dead and decaying trees relate to treated wood poles? Wood poles don't have voids that contain insects --- or do they? Let's look at this question from the woodpecker's perspective.

Wood pole processing, in general, consists of selecting and cutting the tree, peeling away the bark, drying it, then treating it with chemical preservatives. Anyone that has purchased 2x4's from a lumber yard knows that when wood dries it shrinks and cracks. This same cracking phenomenon occurs in treated wood poles, both internally and externally. Externally, the cracks are visible. Internally, cracks or voids are created by separations along the tree's ring lines. Referred to as "shakes", these appear to hold the answer to why a woodpecker will attack a treated wood pole.

Results of tests run by two electric utilities provides an insight into the significance of shakes on woodpecker activity. The tests involved evaluating a number of new wood poles for the presence and location of shakes. In one case an x-ray device was used to locate these voids and in the other the poles were sounded with a hammer. In both cases, the poles were then put into service. After several years, an inventory was taken of woodpecker activity on these poles, and the results correlated against the previously identified shakes. Correlations as high as 80% were reported between wood shakes and woodpecker activity. It appears that woodpeckers are interpreting wood shakes as potential sources of food!

Now that all of the parameters have been defined, let's review **IPOLE-WPD's** *targeted approach* to cost-effective wood pole management.

IPOLE-WPD System - A Targeted Approach to Woodpecker Deterrence

Cost-effective woodpecker deterrence is simply a matter of coupling an effective deterrent with the knowledge of where the woodpecker is most likely to strike. The deterrent is the proven **IPOLE-WPD Woodpecker Deterring System**. On existing poles, the woodpecker has supplied the BLUEPRINT.

Cost-effective woodpecker deterrence involves targeting and applying a limited amount of **IPOLE-WPD** onto select areas of the wood structure. Such areas include:

- Peck-outs, around existing holes, and in other areas of demonstrated woodpecker activity;
- High stress areas of the structure; and
- According to pattern of woodpecker activity on adjacent poles.

Existing woodpecker activity areas provide an excellent blueprint for deterring these creatures of habit. In addition, review of woodpecker activity on adjacent structures can often identify patterns where treatment should also be considered. Tests have shown that coating these identified areas with **IPOLE-WPD** provides a high probability of successful deterrence.

Woodpecker activity in high stress areas of a structure can lead to significant reduction in its service life. These high stress areas include down guys, cross arms, braces, insulators attachments, etc. Coating these attachment areas with **IPOLE-WPD** can reduce woodpecker activity and increase reliability.

IPOLE-WPD Woodpecker Deterring System is available in two forms, Trowelable Putty and Flexible Plastic Sheets.

The **IPOLE-WPD Trowelable Putty** is available in a quart size kit containing Mixing Paddle, Disposable Putty Knife, and Spreading Tool.

The flexible **IPOLE-WPD Pre-Coated Plastic Sheets** are available in 18"x24" sheets that can be cut to size and nailed to the pole.

After more than 30 years of research, safe and cost-effective woodpecker damage repair and deterrence is finally available.
